FIG. 1

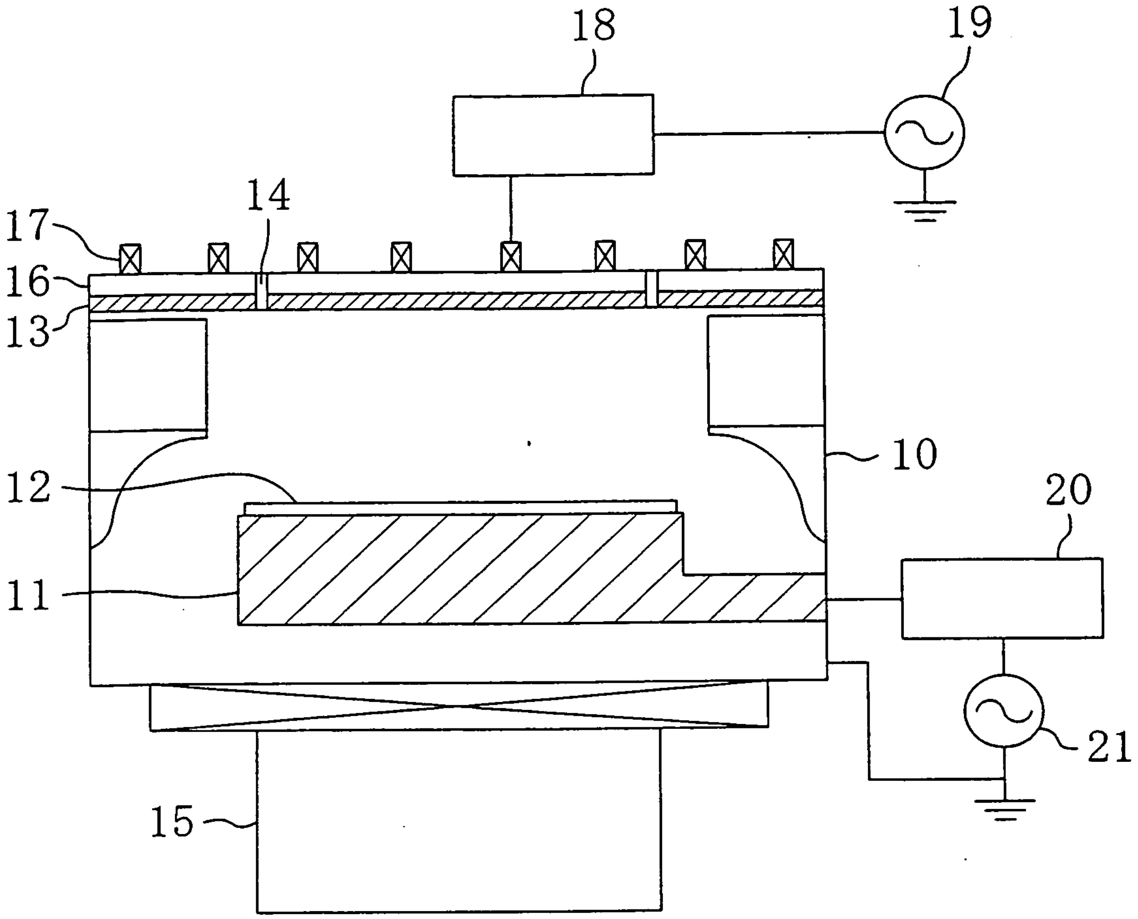


FIG. 2

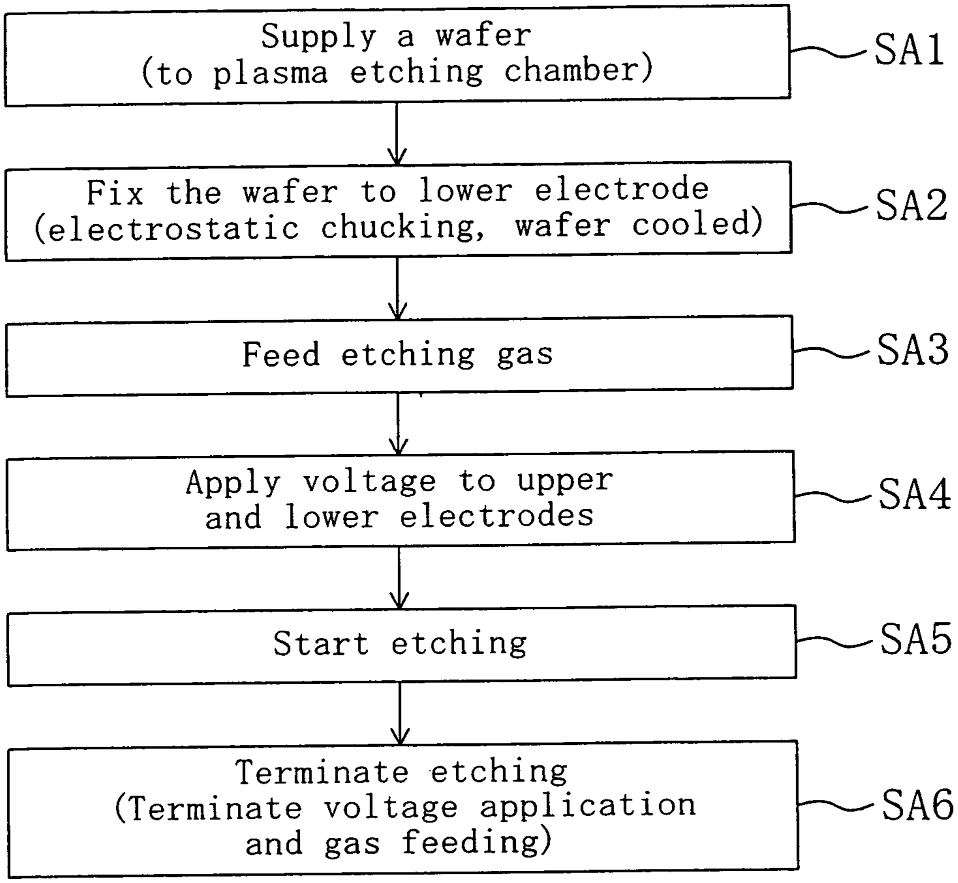

Supply a wafer (to plasma etching chamber)
SA1
Fix the wafer to lower electrode (electrostatic chucking, wafer cooled)
SA2
Feed etching gas
SA3
Apply voltage to upper and lower electrodes
SA4
Start etching
SA5
Terminate etching (Terminate voltage application and gas feeding)
SA6

FIG. 3

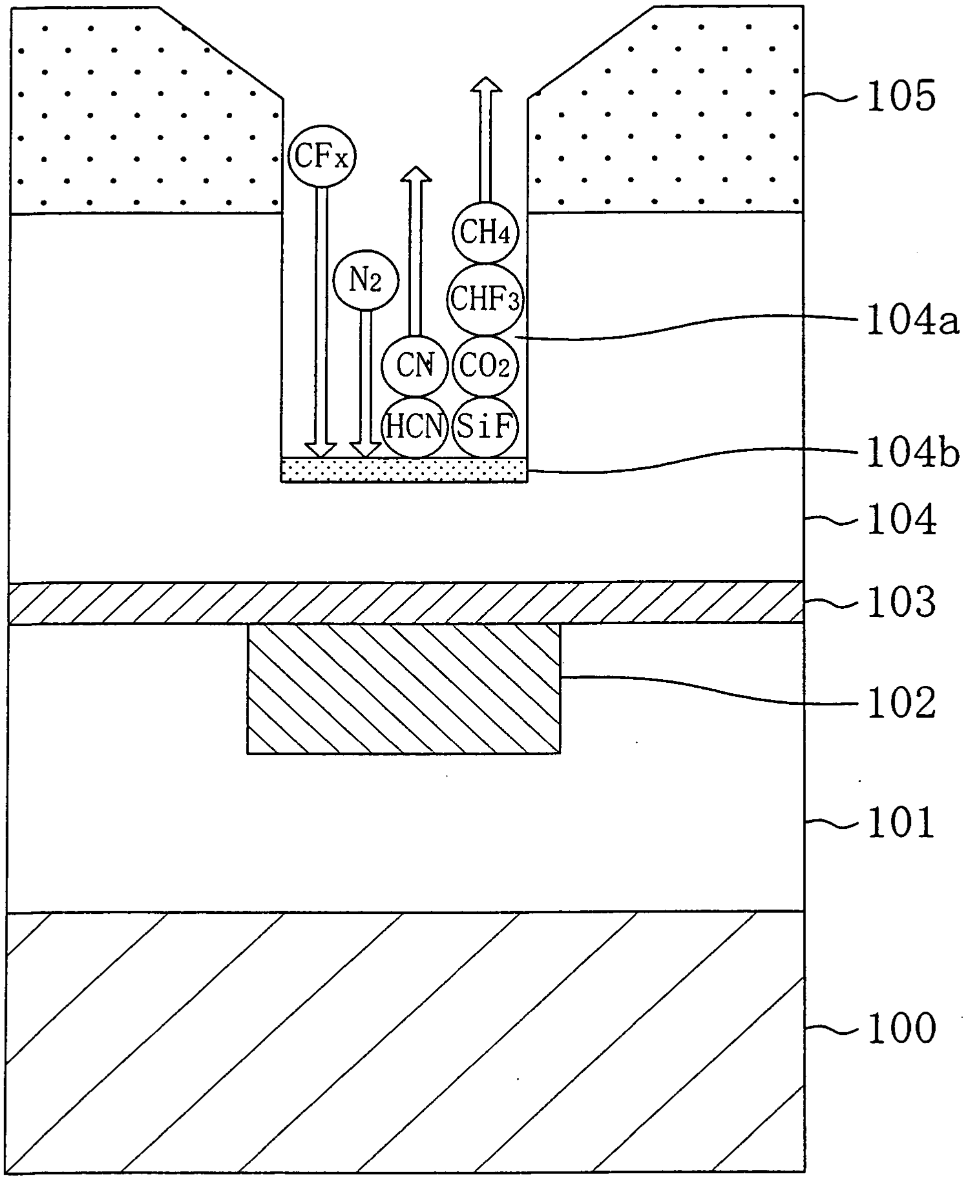


FIG. 4

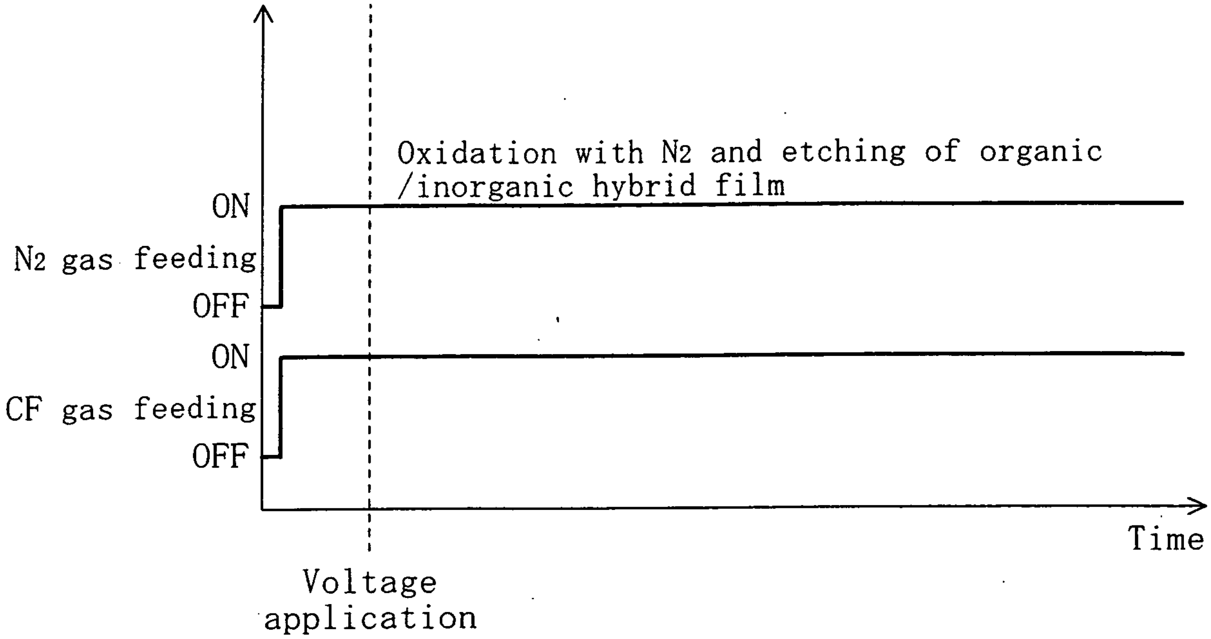
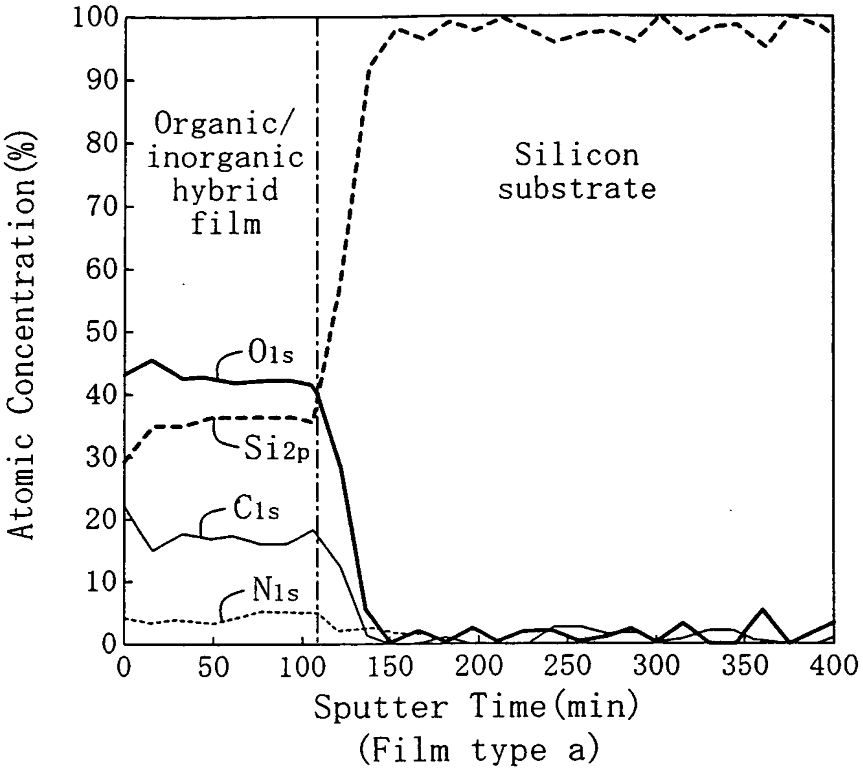
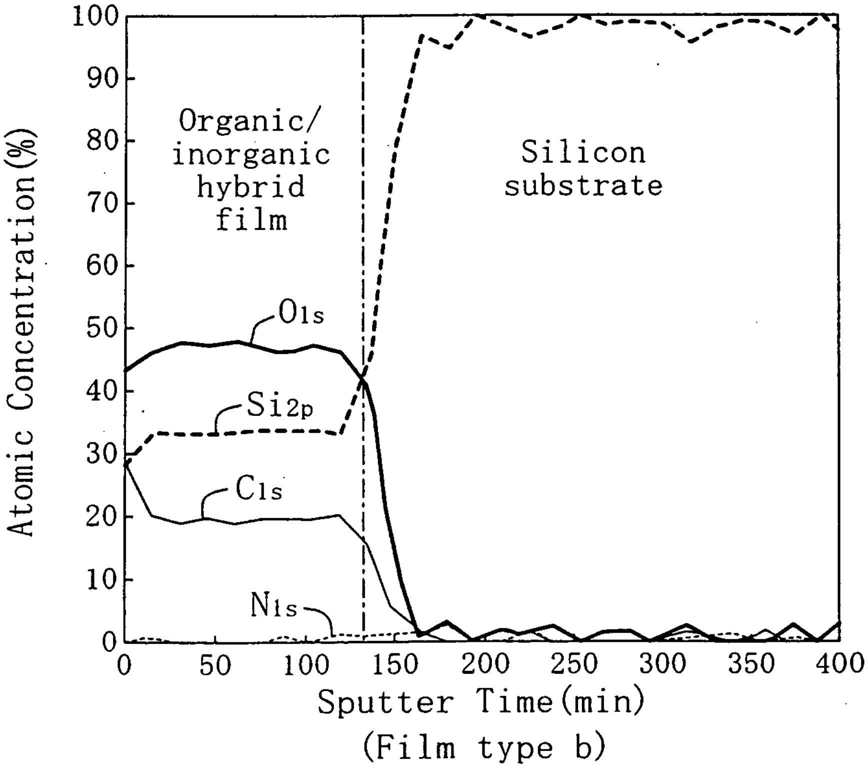

Oxidation with N_2 and etching of organic /inorganic hybrid film
ON
N_2 gas feeding
OFF
ON
CF gas feeding
OFF
Time
Voltage application

FIG. 5(a)



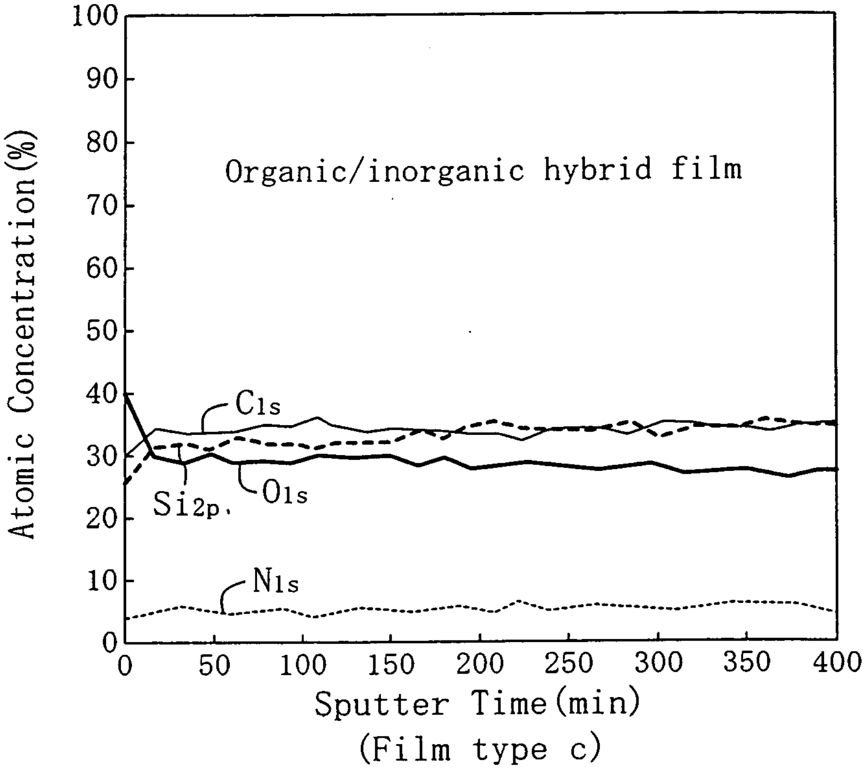
Atomic Concentration(%)
100
90
80
70
60
50
40
30
20
10
0
Organic/ inorganic hybrid film
Silicon substrate
O1s
Si2p
C1s
N1s
0
50
100
150
200
250
300
350
400
Sputter Time(min)
(Film type a)

FIG. 5(b)



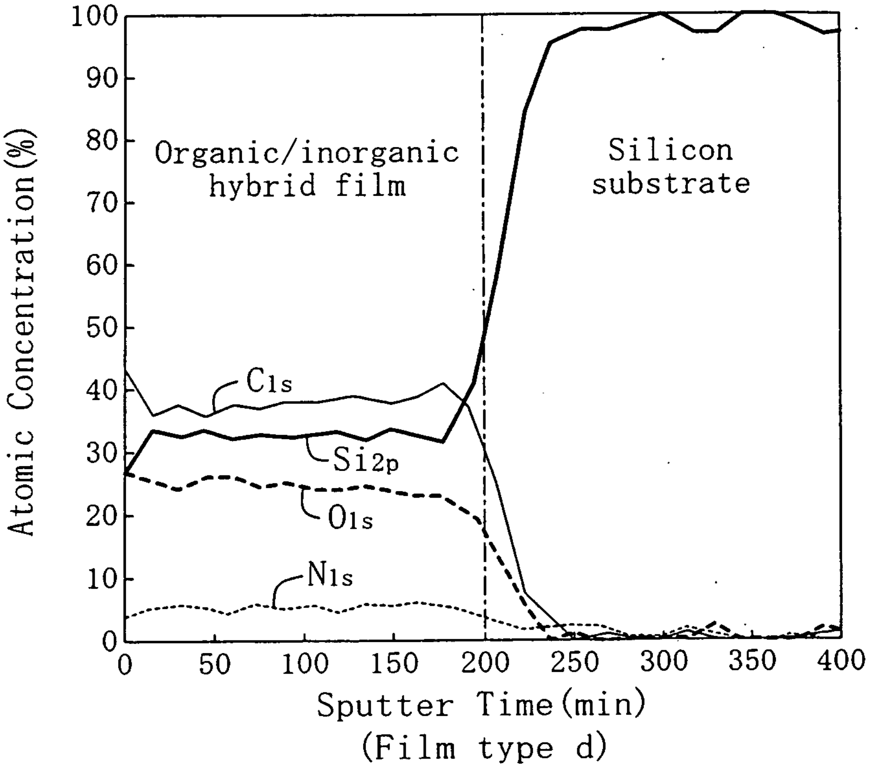
Atomic Concentration(%)
100
90
80
70
60
50
40
30
20
10
0
Organic/ inorganic hybrid film
Silicon substrate
O1s
Si2p
C1s
N1s
0
50
100
150
200
250
300
350
400
Sputter Time(min)
(Film type b)

FIG. 6(a)



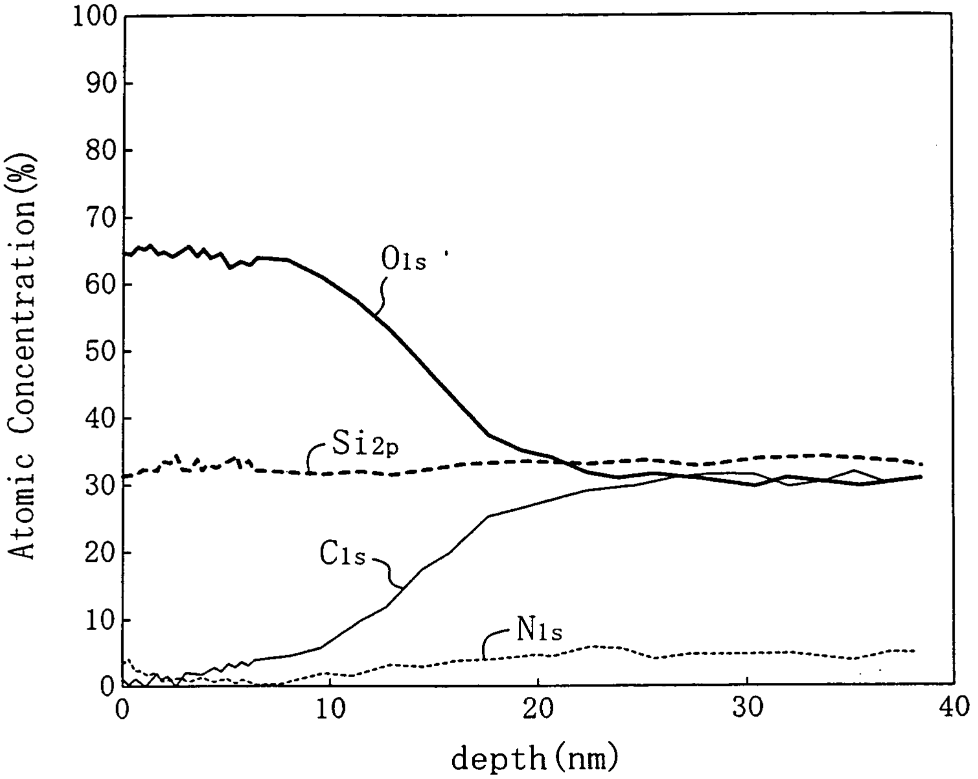
Organic/inorganic hybrid film
Atomic Concentration(%)
100
90
80
70
60
50
40
30
20
10
0
C1s
Si2p
O1s
N1s
0
50
100
150
200
250
300
350
400
Sputter Time(min)
(Film type c)

FIG. 6(b)



Organic/inorganic hybrid film
Silicon substrate
Atomic Concentration(%)
100
90
80
70
60
50
40
30
20
10
0
C1s
Si2p
O1s
N1s
0
50
100
150
200
250
300
350
400
Sputter Time(min)
(Film type d)

FIG. 7



Atomic Concentration(%)
100
90
80
70
60
50
40
30
20
10
0
0
10
20
30
40
depth(nm)
O1s
Si2p
C1s
N1s

FIG. 8

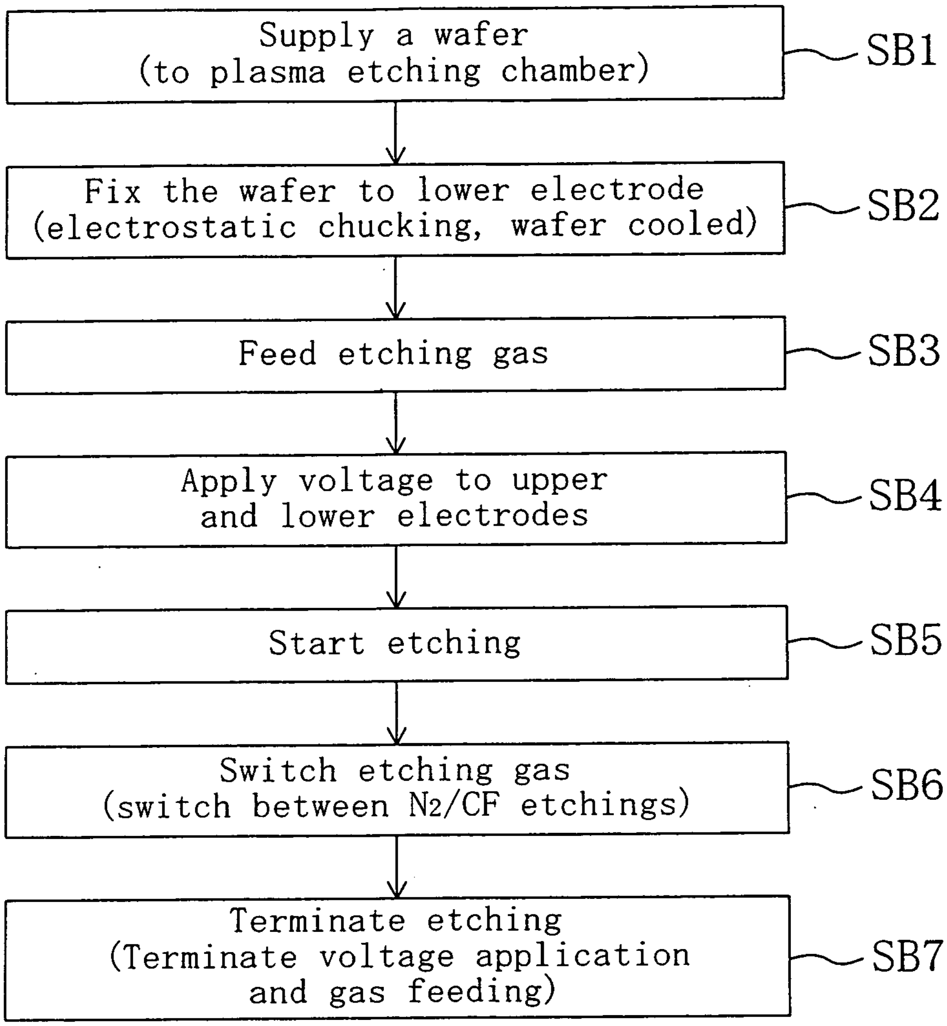
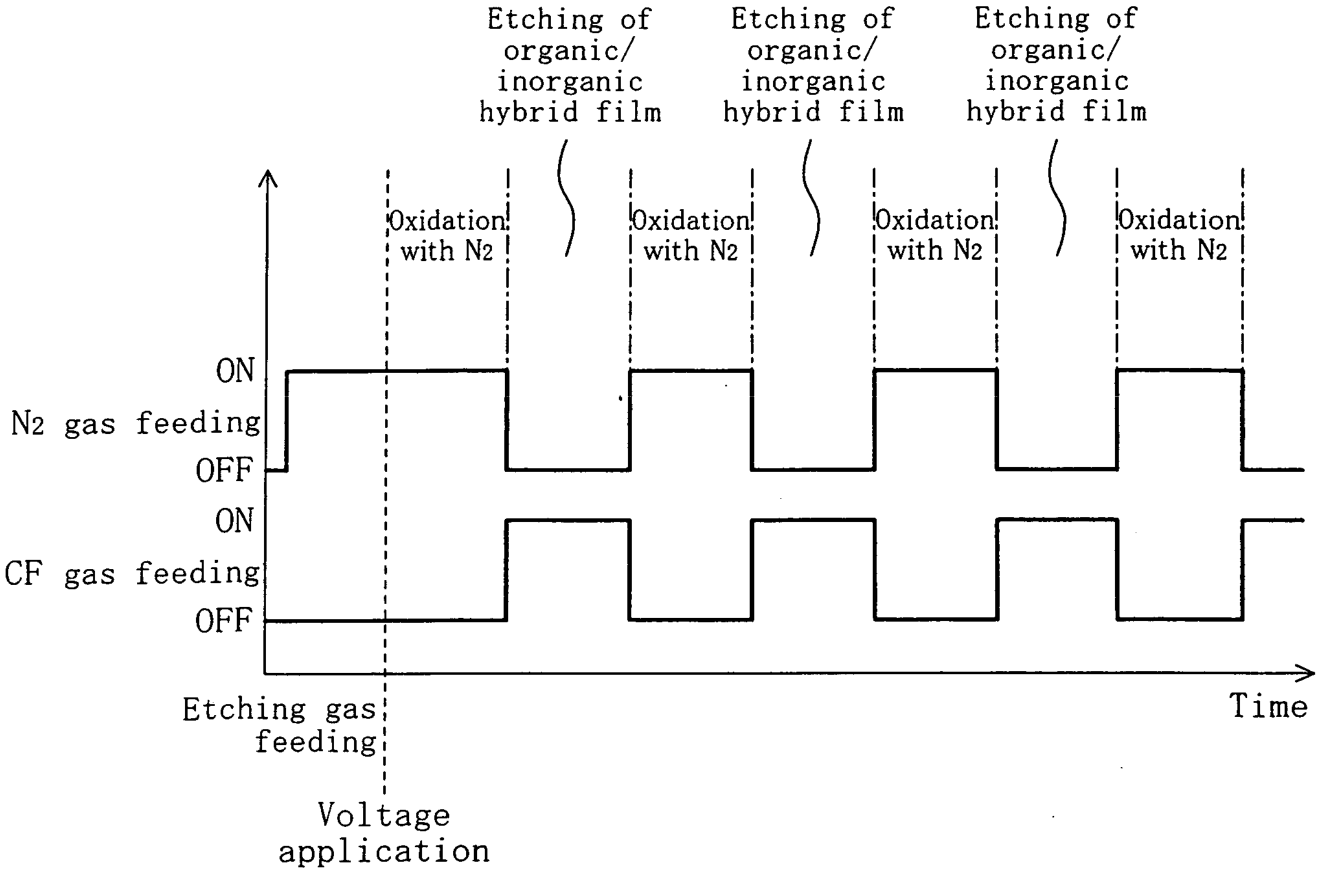

Supply a wafer (to plasma etching chamber)
SB1
Fix the wafer to lower electrode (electrostatic chucking, wafer cooled)
SB2
Feed etching gas
SB3
Apply voltage to upper and lower electrodes
SB4
Start etching
SB5
Switch etching gas (switch between N2/CF etchings)
SB6
Terminate etching (Terminate voltage application and gas feeding)
SB7

FIG. 9


Etching of organic/ inorganic hybrid film
Etching of organic/ inorganic hybrid film
Etching of organic/ inorganic hybrid film
Oxidation with N2
Oxidation with N2
Oxidation with N2
Oxidation with N2
ON
N2 gas feeding
OFF
ON
CF gas feeding
OFF
Etching gas feeding
Time
Voltage application

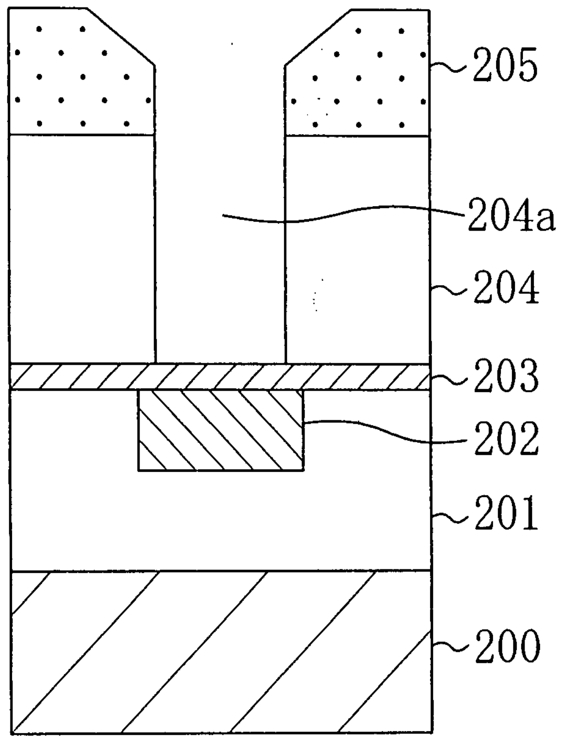


FIG. 10(a)

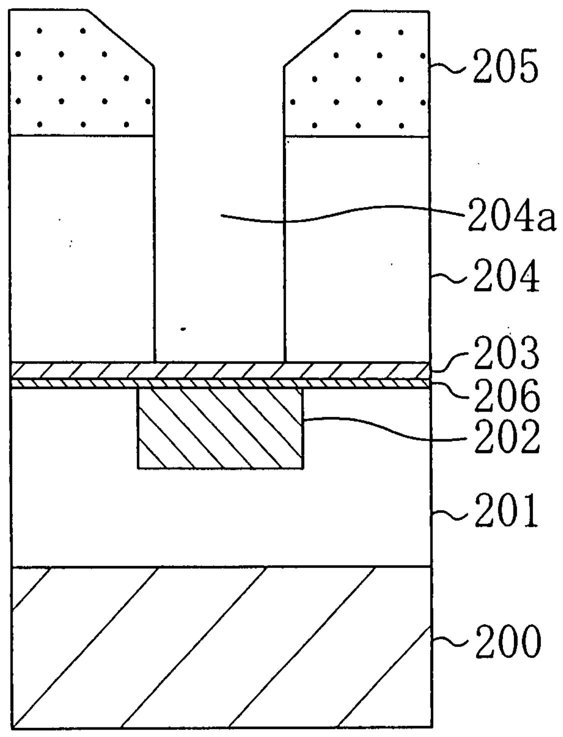


FIG. 10(b)

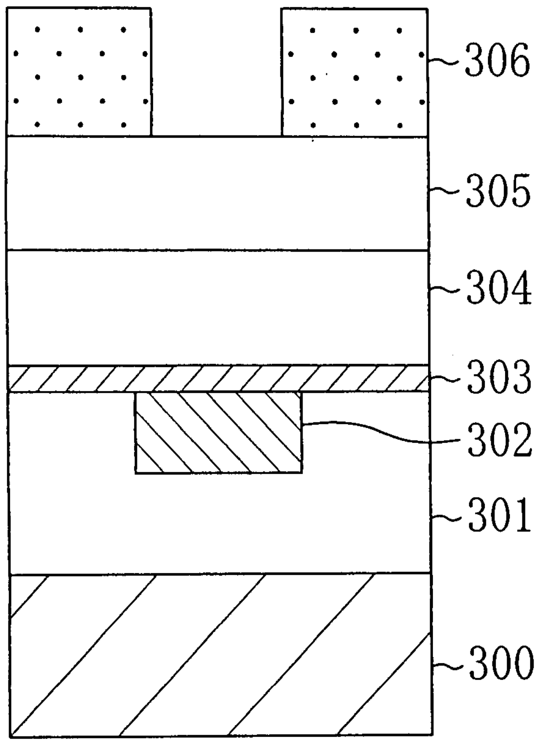


FIG. 11(a)

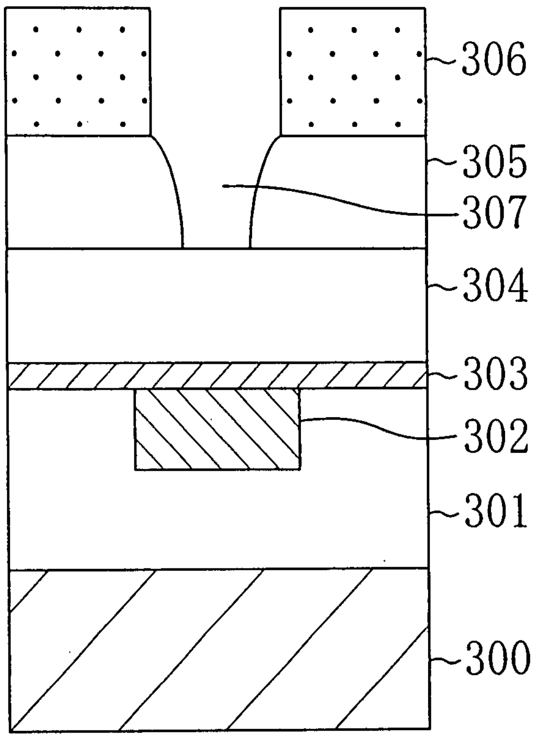


FIG. 11(b)

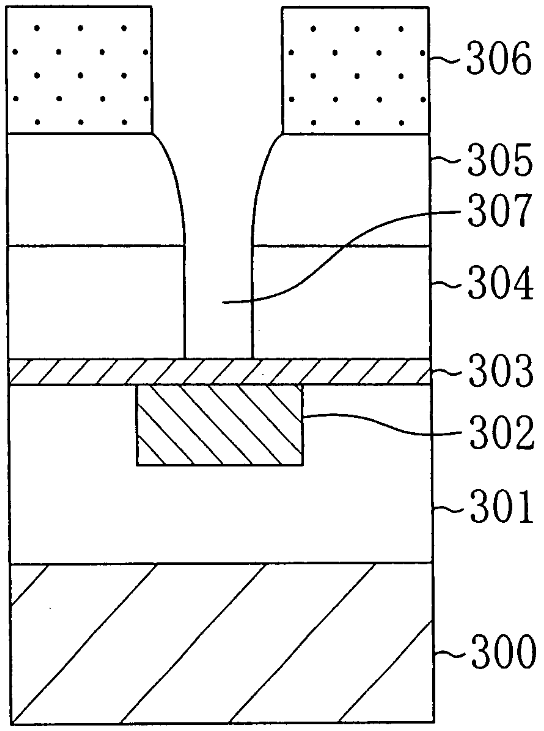


FIG. 11(c)

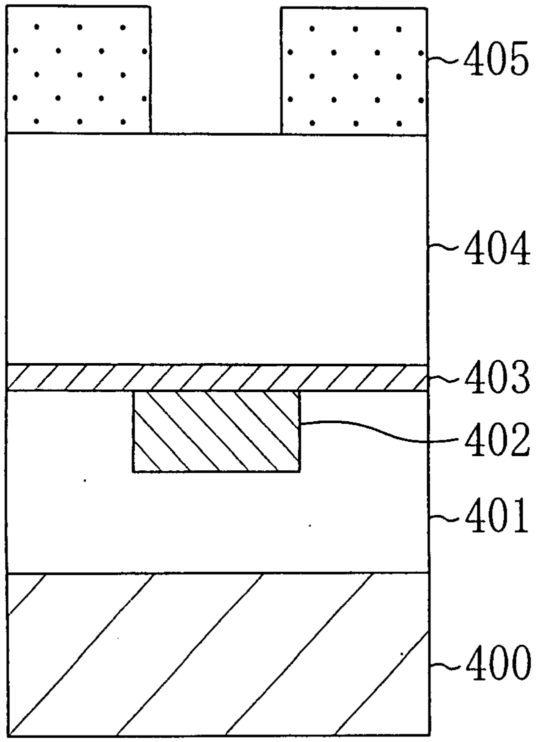


FIG. 12(a)

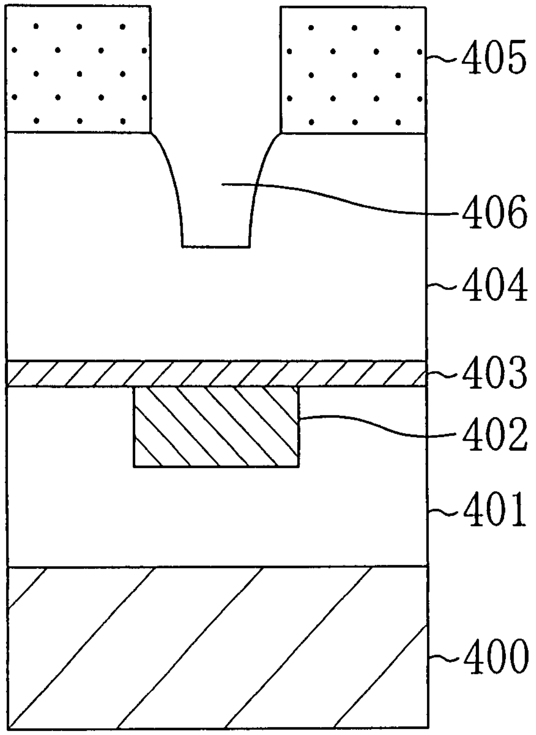


FIG. 12(b)

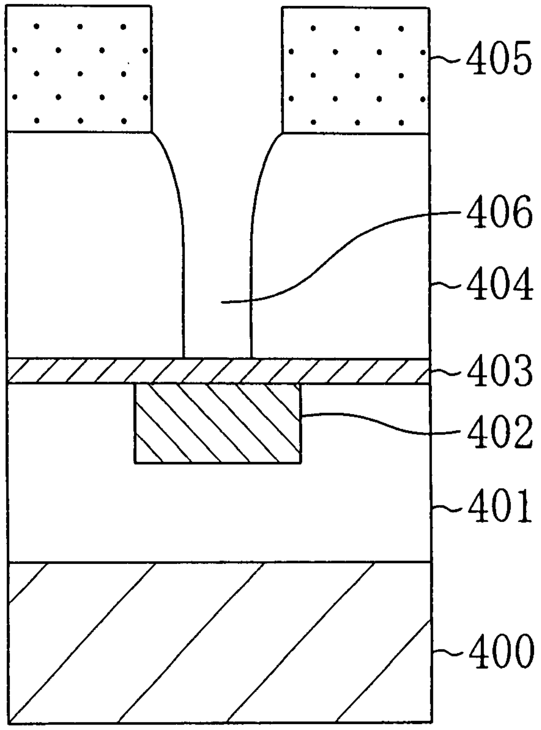


FIG. 12(c)

FIG. 13

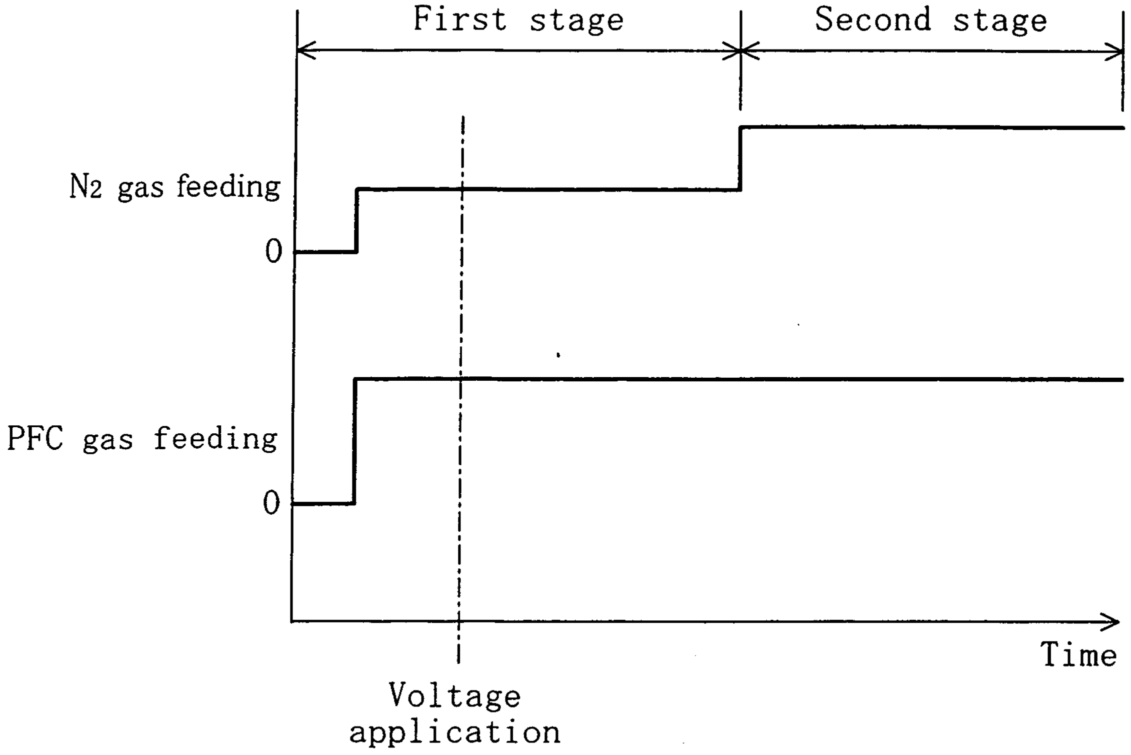

First stage
Second stage
N2 gas feeding
0
PFC gas feeding
0
Time
Voltage application

FIG. 14(a)

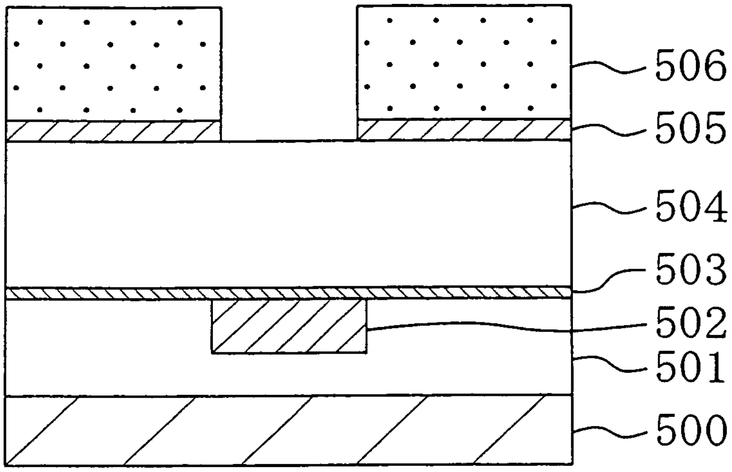


FIG. 14(b)

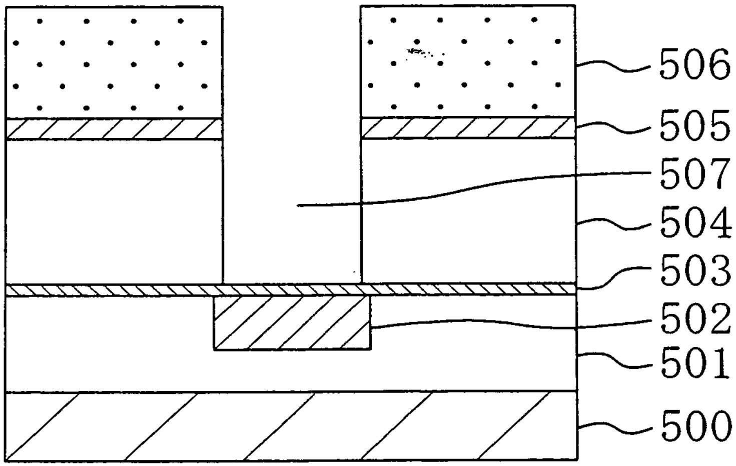
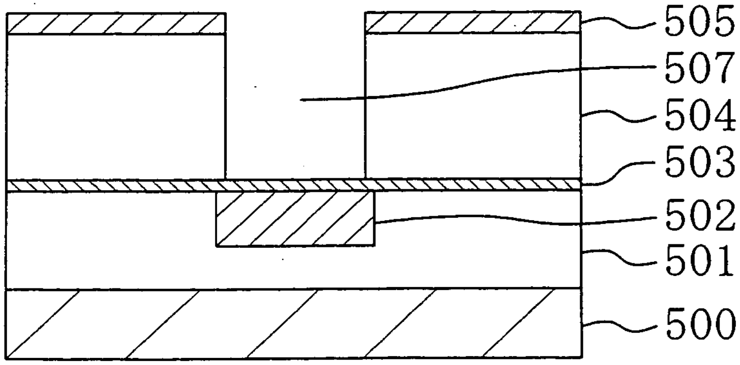


FIG. 14(c)



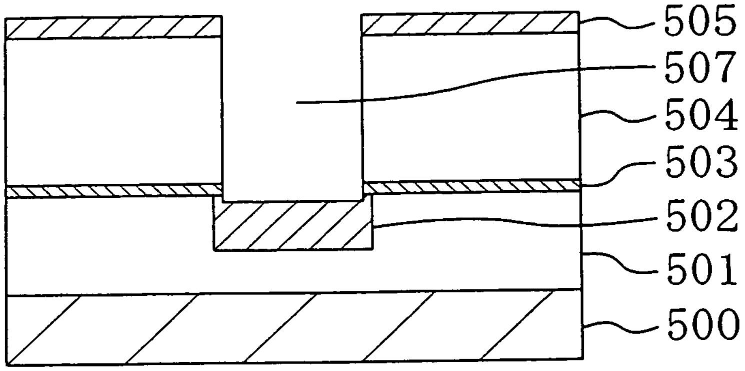


FIG. 15(a)

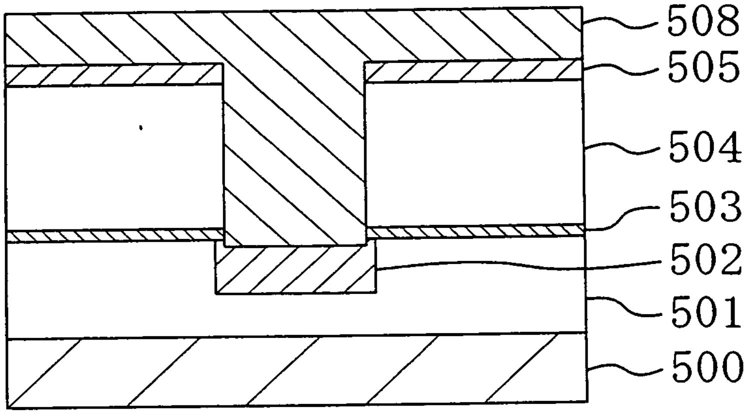


FIG. 15(b)

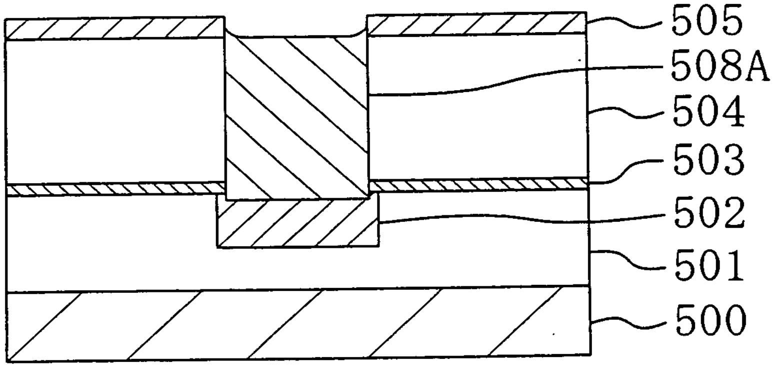


FIG. 15(c)

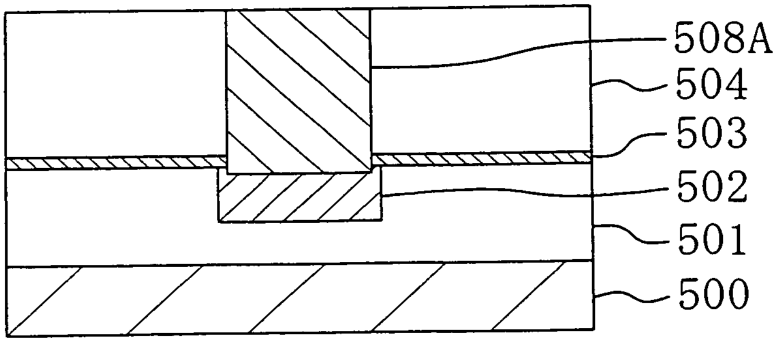


FIG. 15(d)

FIG. 16(a)

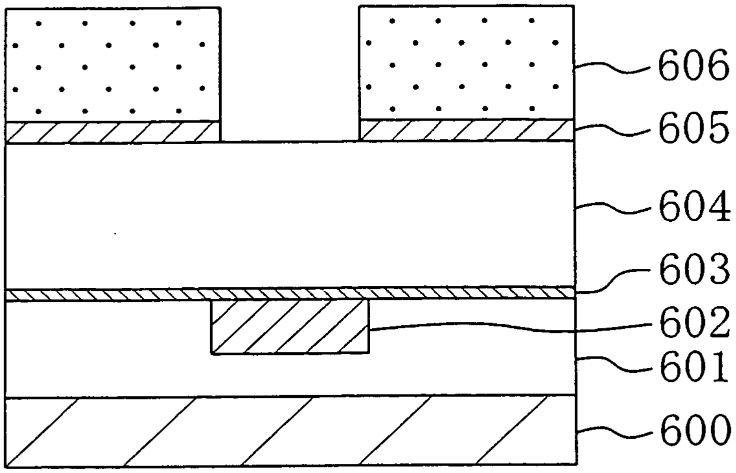


FIG. 16(b)

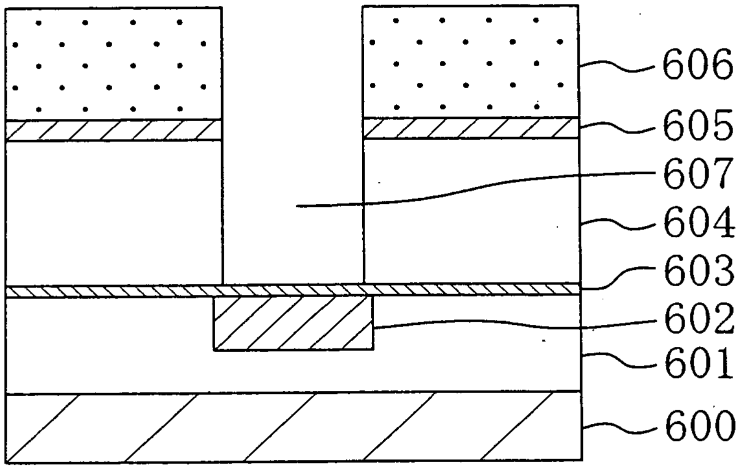


FIG. 16(c)

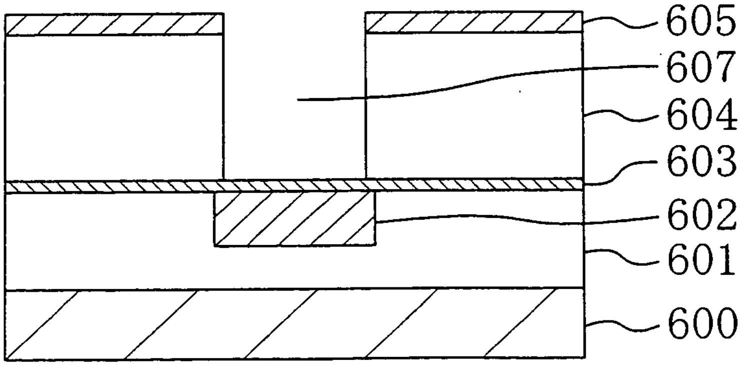


FIG. 17(a)

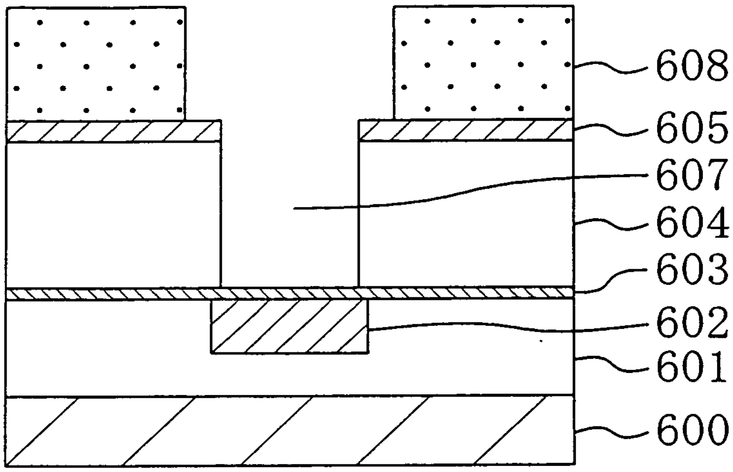


FIG. 17(b)

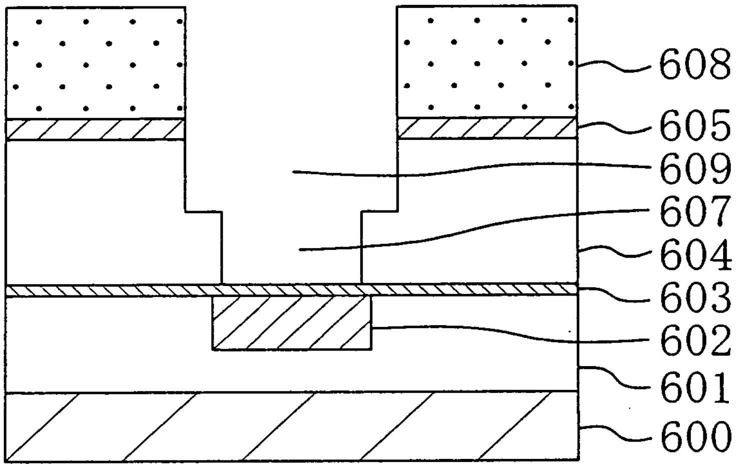


FIG. 17(c)

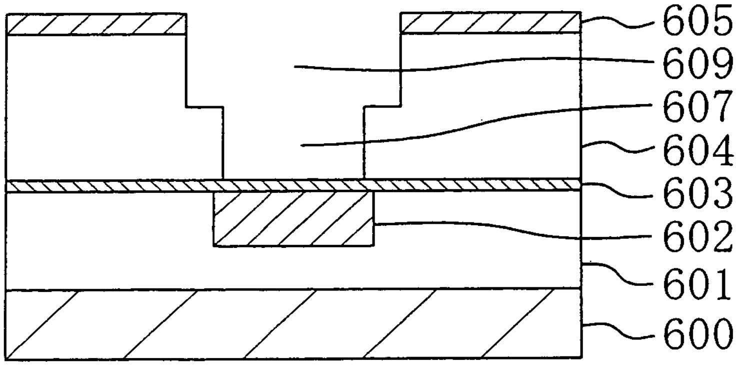


FIG. 18(a)

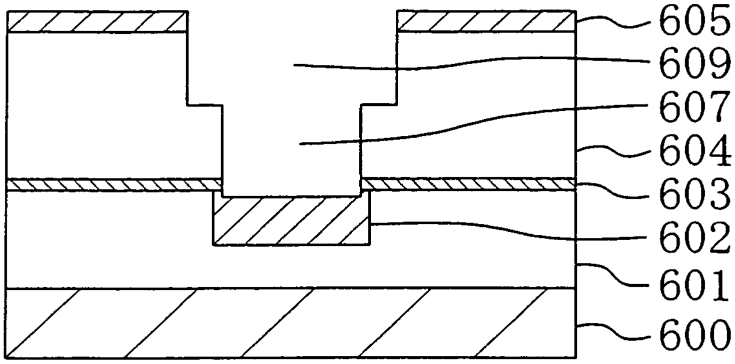


FIG. 18(b)

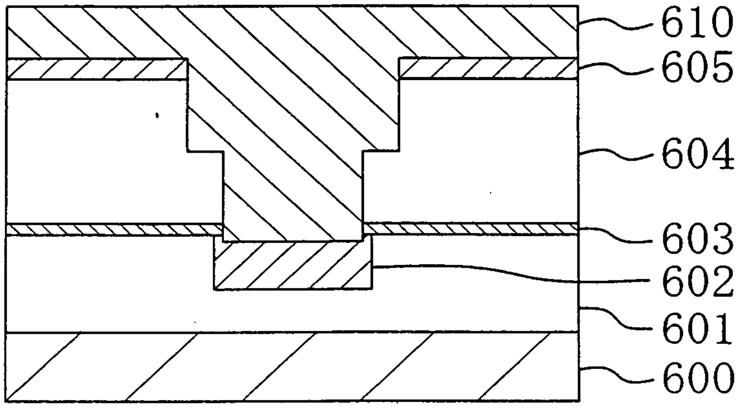


FIG. 18(c)

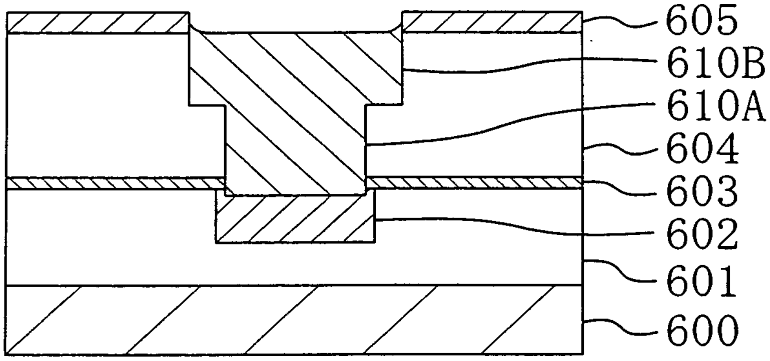
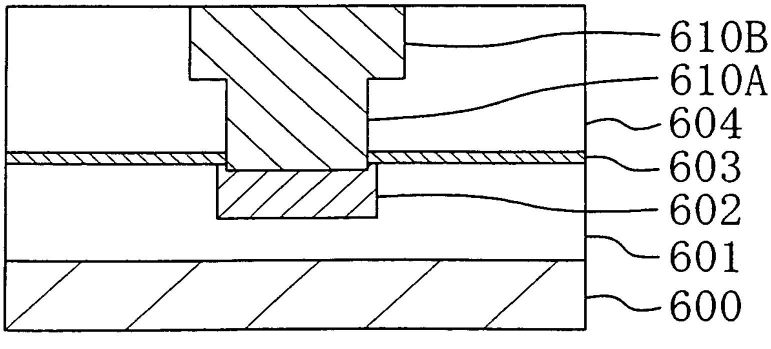


FIG. 18(d)



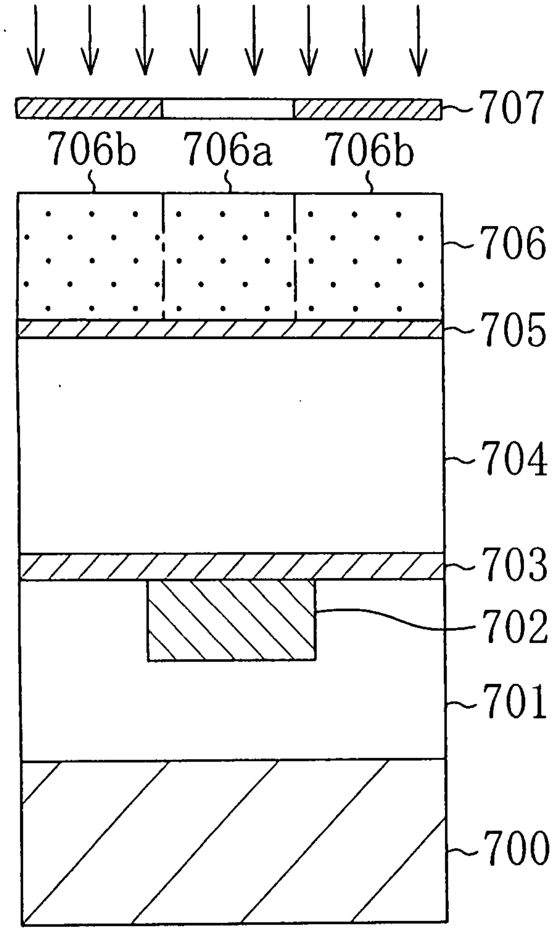


FIG. 19(a)

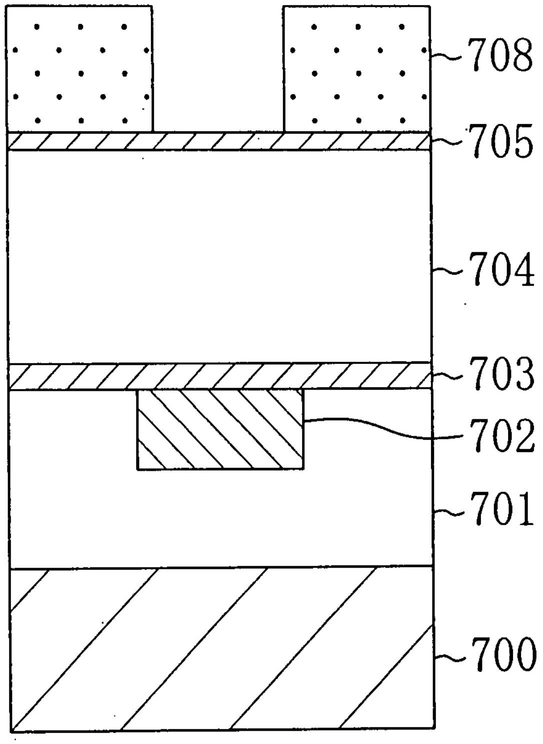


FIG. 19(b)

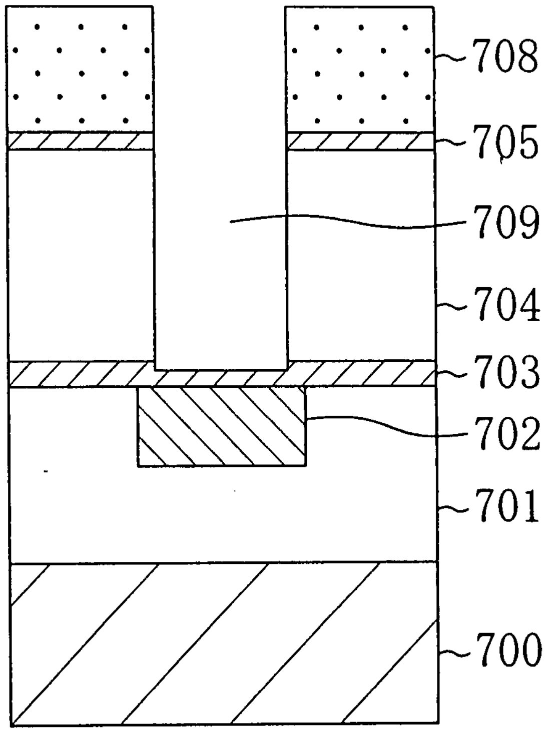


FIG. 19(c)

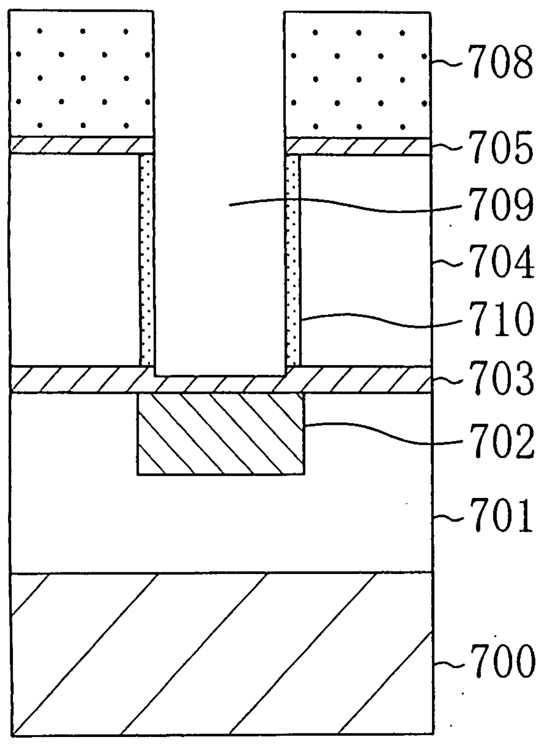


FIG. 20(a)

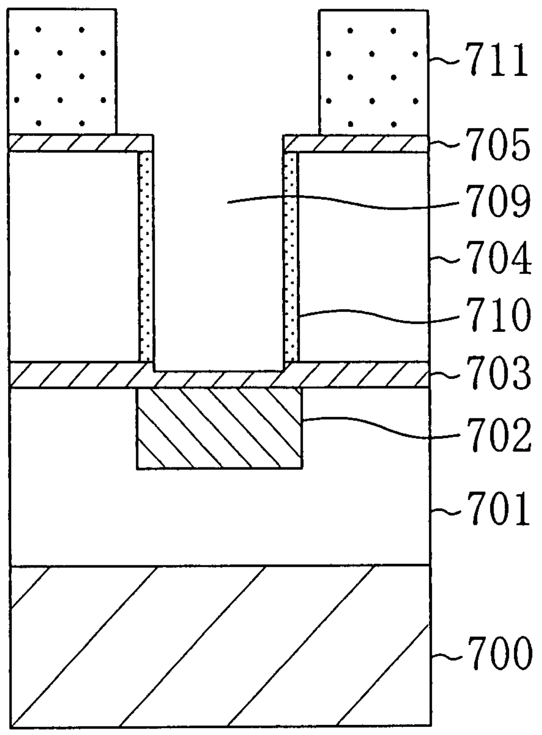


FIG. 20(b)

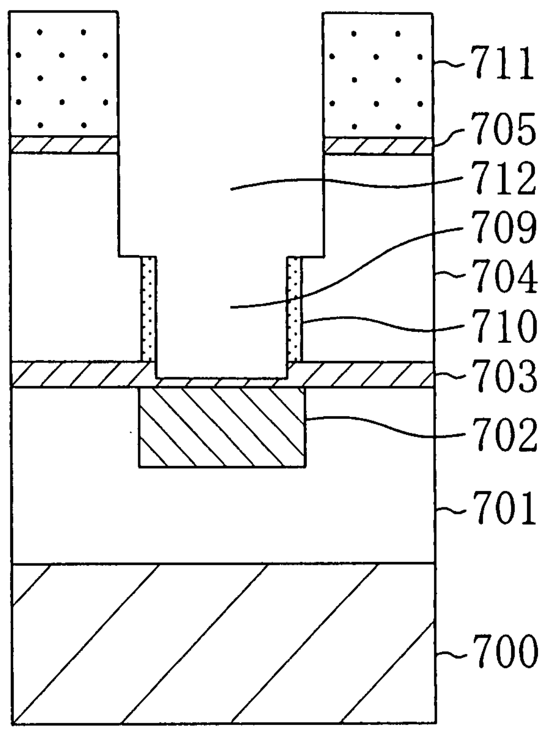


FIG. 20(c)

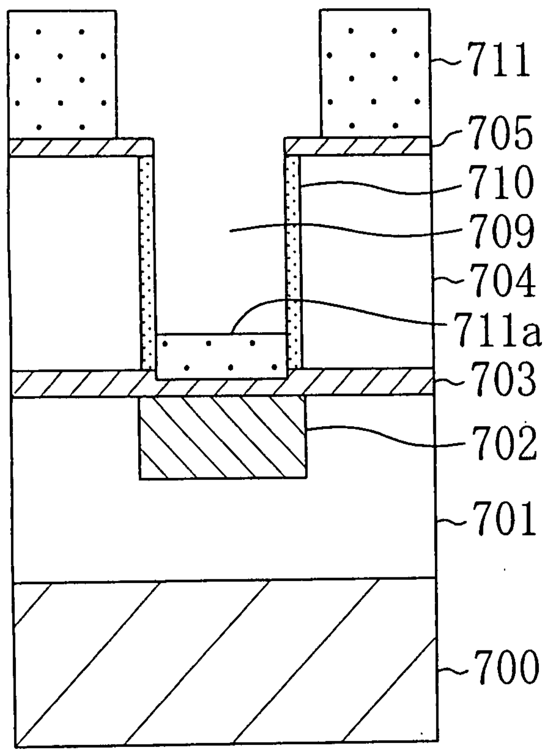


FIG. 21(a)

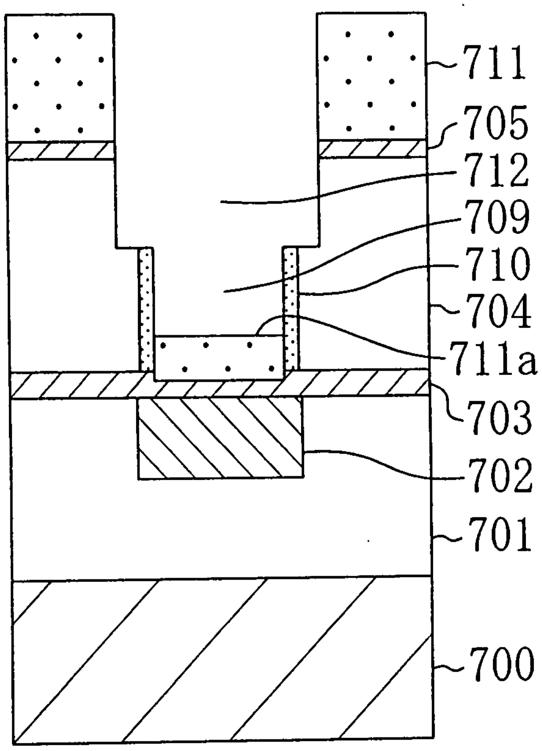


FIG. 21(b)

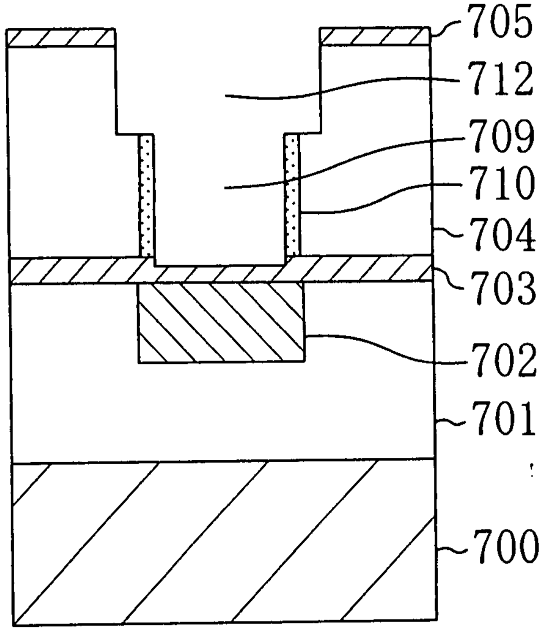


FIG. 21(c)

FIG. 22(a)
PRIOR ART

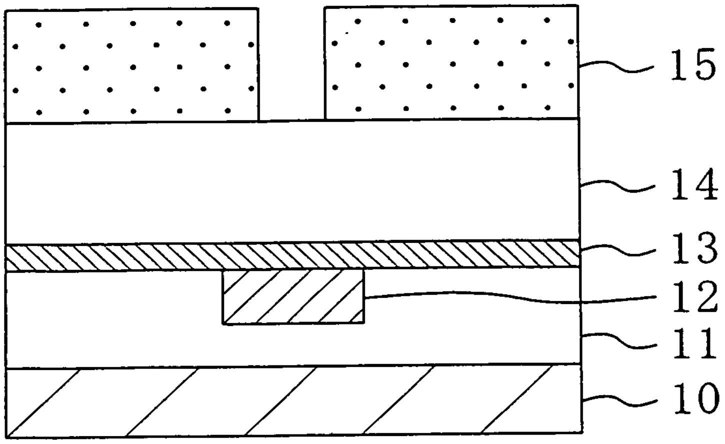


FIG. 22(b)
PRIOR ART

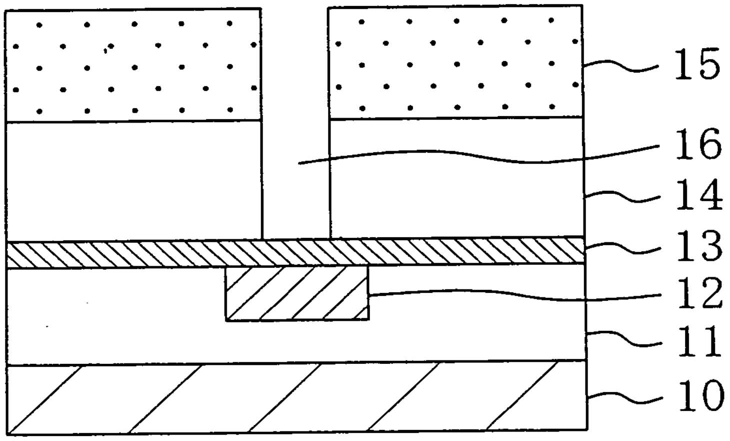


FIG. 22(c)
PRIOR ART

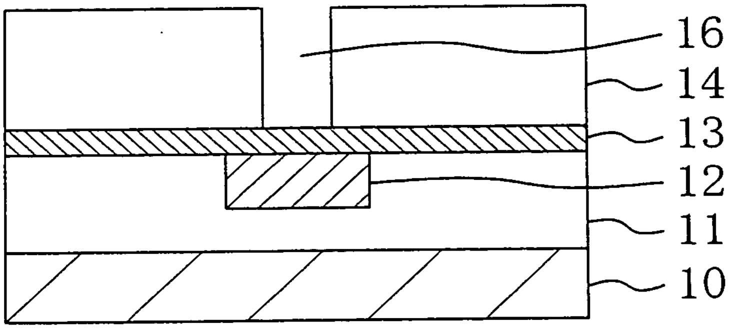
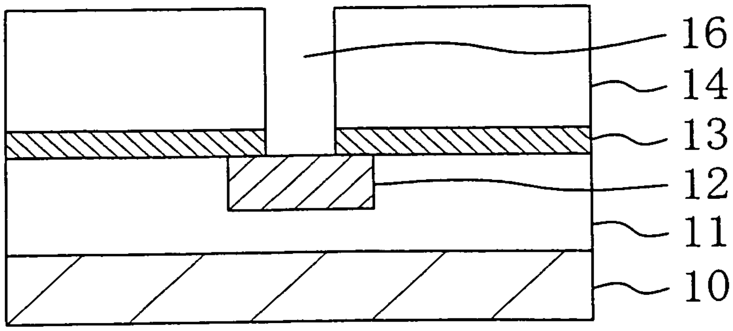


FIG. 22(d)
PRIOR ART



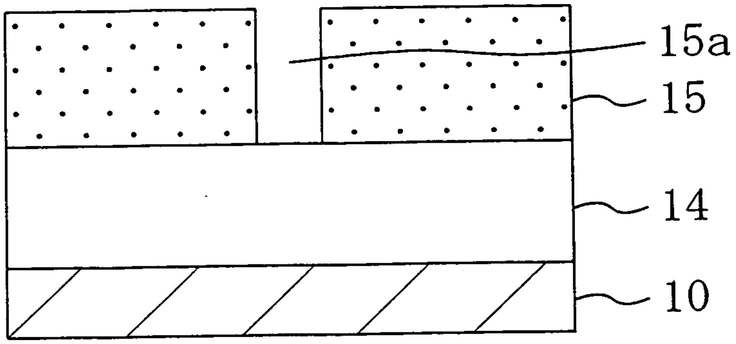


FIG. 23(a)
PRIOR ART

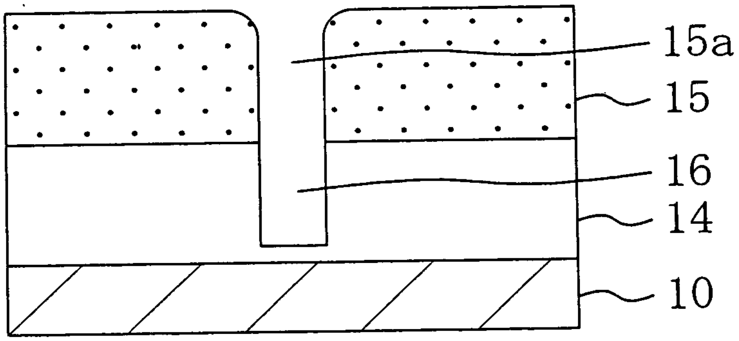


FIG. 23(b)
PRIOR ART

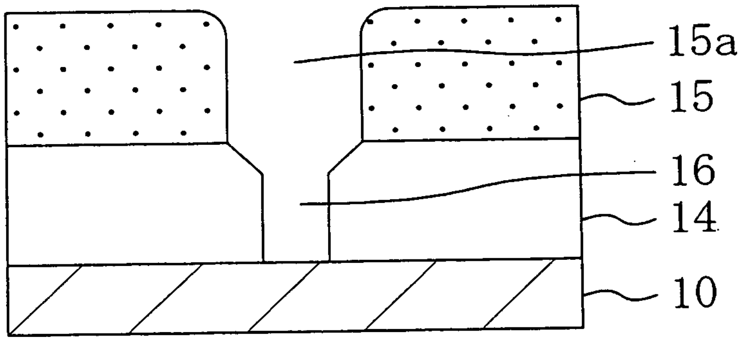


FIG. 23(c)
PRIOR ART

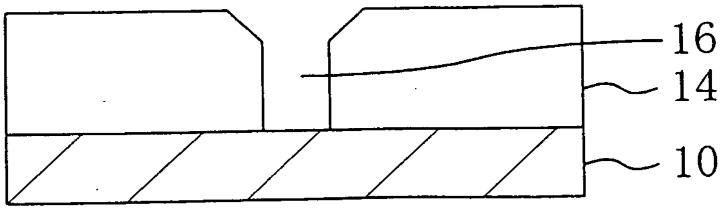


FIG. 23(d)
PRIOR ART

FIG. 24(a)

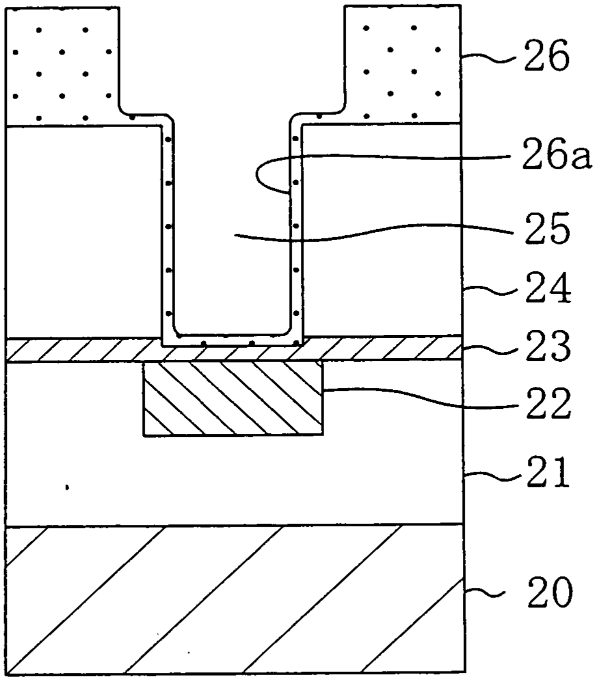


FIG. 24(b)

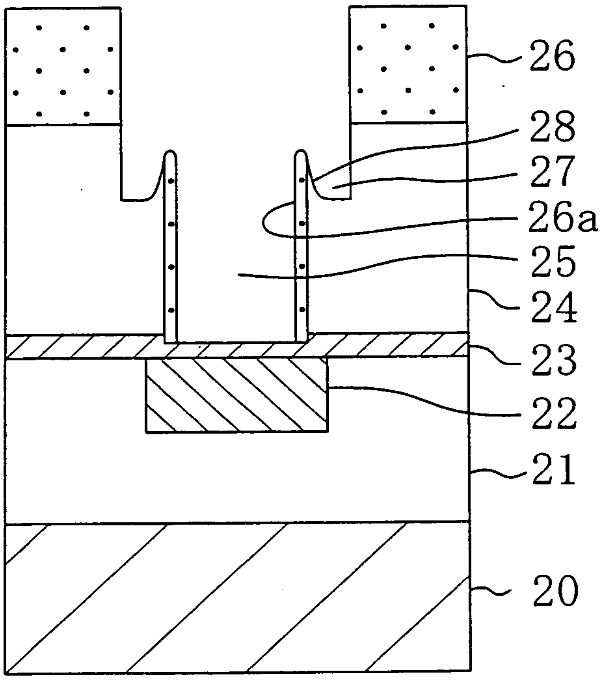


FIG. 25

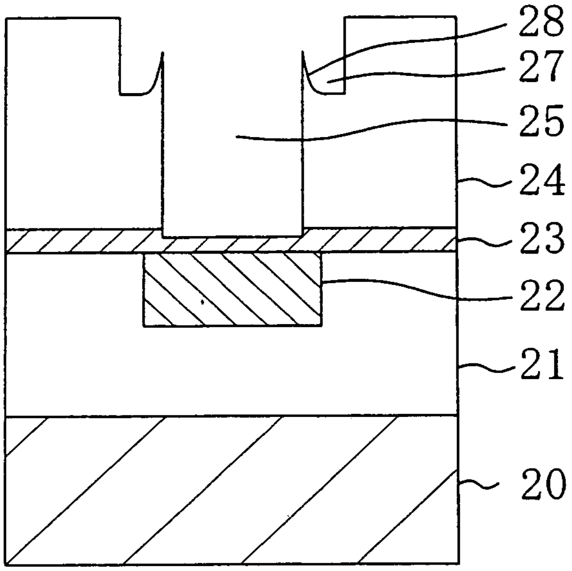


FIG. 26(a)

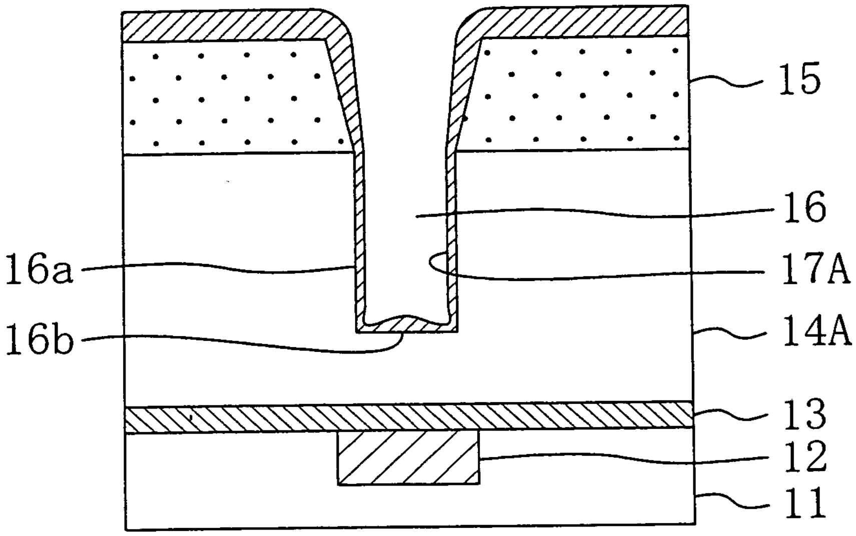


FIG. 26(b)